

# **45**

## **Temporary Transcutaneous (External) Pacing**

**P U R P O S E:** Transcutaneous or external pacing is used to stimulate myocardial depolarization through the chest wall. External pacing is initiated as a temporary measure when there has been a failure of the normal conduction system of the heart to produce an electric impulse resulting in hemodynamic compromise or other debilitating symptoms in the patient.

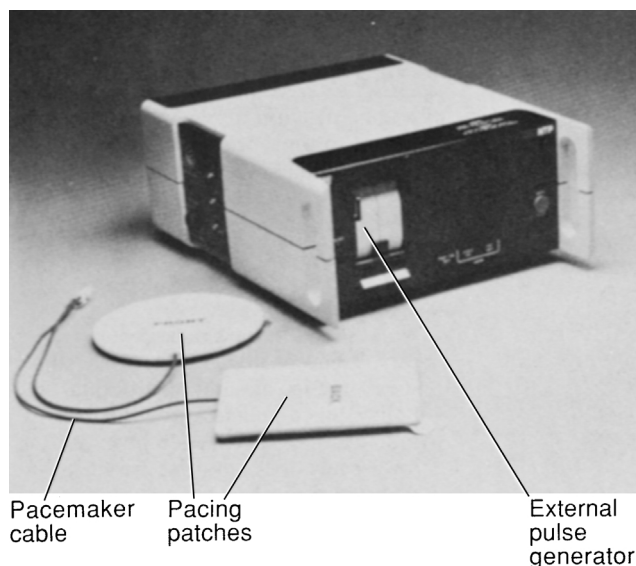
*Francine E. Paschall  
Ellen Strauss McErlean*

### **PREREQUISITE NURSING KNOWLEDGE**

- The normal anatomy and physiology of the cardiovascular system, principles of cardiac conduction, and basic dysrhythmia interpretation should be understood.
- Transcutaneous pacemakers should be understood so that pacemaker function and the patient response to pacemaker therapy can be evaluated.
- Clinical and technical competence related to use of the transcutaneous pacemaker is necessary.
- Advanced cardiac life support knowledge and skills are necessary.
- Transcutaneous pacing is most commonly used to stimulate the myocardium to depolarize in the absence of an intrinsic rhythm, establish an adequate cardiac output and blood pressure to ensure tissue perfusion to vital organs, and reduce the possibility of ventricular dysrhythmias in the presence of bradycardia.
- Indications for transcutaneous pacing include the following:
  - ❖ Asystolic cardiac arrest (American Heart Association asystole treatment algorithm)<sup>1</sup>
  - ❖ Symptomatic bradycardia
  - ❖ Temporary bridge in the presence of long-term pacemaker failure, revision, or replacement before placement of temporary transvenous pacemaker
  - ❖ Temporary bridge in the presence of Type II second-degree atrioventricular (AV) heart block or third-degree AV heart block before placement of temporary transvenous pacemaker
  - ❖ Cardioactive drug toxicity
  - ❖ Anesthesia-induced bradycardia
  - ❖ Patients for whom temporary pacing is necessary yet for whom invasive techniques are contraindicated: those with immunosuppression, severe vascular disease, high-bleeding risk, and sepsis; pretransplant candidates; and posttransplant patients
  - ❖ Emergent overdrive suppression or termination of su-

praventricular and ventricular tachydysrhythmias before placement of temporary transvenous pacemaker

- External cardiac pacing is a method of stimulating myocardial depolarization through the chest wall via two large pacing electrodes. The electrodes are placed on the anterior and posterior chest wall and are attached by a cable to an external pulse generator that houses the pacemaker controls (Fig. 45–1).
- Basic principles of cardiac pacing include sensing, pacing, and capture:
  - ❖ *Sensing* refers to the ability of the pacemaker to detect intrinsic myocardial electrical activity. Sensing occurs if the pacemaker is in the synchronous or demand



■ ● **FIGURE 45–1.** Temporary transcutaneous (external) pacemaker. (From Zoll Medical Corporation, Burlington, MA.)

mode. The pacemaker either will be inhibited from delivering a stimulus or will initiate an electrical impulse.

- ❖ *Pacing* occurs once the external pulse generator is activated and the specified level of energy travels from the external pulse generator through the pacing patches, through the patient's chest, to the myocardium. This is known as *pacer firing* and is represented as a *spike* on the electrocardiogram (ECG) tracing.
- ❖ *Capture* refers to the successful stimulation of the myocardium by the pacemaker impulse, resulting in depolarization. It is evidenced on the ECG by a pacemaker spike followed by either an atrial or a ventricular complex, depending on the chamber paced. External pacing provides only single-chamber ventricular pacing.
- An understanding of the various pacing modes is necessary:
  - ❖ Temporary external pacing is capable of delivering ventricular asynchronous or ventricular synchronous pacing.
  - ❖ Asynchronous pacing is initiated only in an emergency to establish an immediate rhythm.
  - ❖ Synchronous pacing is the recommended mode of transcutaneous pacing. When the pacing rate is set above the patient's intrinsic heart rate, the patient will be paced continuously unless the pacemaker senses an intrinsic complex. If the pacemaker senses an intrinsic complex, the pacemaker will be inhibited from initiating a pacing impulse. When the pacing rate is set below the patient's intrinsic rate, the pacemaker will initiate pacing when the heart rate falls below the desired set rate.
- The efficacy of external pacing is influenced by a number of variables: the position and adherence of the pacing electrodes, the level of energy delivered to the myocardium, the presence of acidosis or electrolyte imbalances, concomitant drug therapy (especially antidysrhythmic therapy), and anatomic features of the patient (eg, barrel chest, obesity).
- Principles of general electric safety apply when using external pacing. Biomedical engineering or other medical safety personnel should be familiar with the manufacturer's specific recommendations with reference to safety.

## EQUIPMENT

- External pacing generator and monitor unit (see Fig. 45–1)
- Pacing cable and pacing patches (see Fig. 45–1)
- Pacemaker electrodes
- ECG electrode patches
- ECG monitor and cable

Additional equipment (to have available depending on patient need) includes the following:

- Scissors to remove body hair
- Emergency medications and resuscitation equipment

## PATIENT AND FAMILY EDUCATION

- Assess learning needs, readiness to learn, and factors that will influence learning. **➤Rationale:** Individualizes

teaching so that it will be meaningful to the patient and family.

- Discuss basic facts about the normal conduction system, such as structure of the conduction system, source of heart rate, normal and abnormal heart rhythms, and symptoms of abnormal heart rhythms. **➤Rationale:** Understanding of the normal conduction system will assist the patient and family in recognizing the seriousness of the patient's condition and the need for external pacing.
- Discuss basic facts about the external pacemaker, such as the reason for the pacemaker, explanation of the equipment, what to expect during the procedure, what to expect after the procedure, and adjuncts to pacing therapy (ie, medications). **➤Rationale:** Understanding of pacemaker functioning and expectations of the procedure will assist the patient and family in developing a realistic perception of the procedure and how it will help the patient.
- Describe the potential sensations the patient may experience, such as involuntary muscular contraction. **➤Rationale:** Prepares patient and family for what may be expected normally.
- Discuss possible interventions to alleviate discomfort experienced. **➤Rationale:** Provides patient with an opportunity to validate perceptions. Gives the patient and family knowledge that interventions will be used to minimize the level of discomfort.
- If indicated, inform patient and family of the possibility of the need for transvenous or permanent pacing support. **➤Rationale:** Prepares patient and family for additional therapy. If permanent pacing is required, the patient and family will need further instruction about possible lifestyle modifications and follow-up visits and information about the pacemaker to be implanted.

## PATIENT ASSESSMENT AND PREPARATION

### Patient Assessment

- Assess cardiac rhythm for the presence of bradydysrhythmias (including AV block), bradydysrhythmias associated with premature ventricular contractions, tachydysrhythmias, or asystole. **➤Rationale:** The presence of these dysrhythmias may warrant the need for transcutaneous pacing.
- Determine hemodynamic response to the dysrhythmia, such as a systolic blood pressure of less than 90 mm Hg; altered level of consciousness; complaints of dizziness, shortness of breath, or nausea and vomiting; cool, clammy, diaphoretic skin; or the development of chest pain. **➤Rationale:** The decision to intervene once specific cardiac dysrhythmias are noted depends on the effect of the dysrhythmia on the patient's cardiac output. Assessment of clinical parameters that reflect a decreased cardiac output will allow the health care team to determine whether pacing is indicated.
- Review of current medications. **➤Rationale:** Medications such as digoxin, calcium channel blockers, and beta blockers alter AV nodal conduction and may be implicated as a cause for the dysrhythmia or reevaluated for concomitant effect on the conduction system. Other med-

ications, especially antidysrhythmics, may alter the pacing threshold.

- Review current laboratory studies, including chemistry or electrolyte profile and digoxin or other cardioactive drug levels. **➤Rationale:** Assists in determining if the need for external pacing was precipitated by metabolic disturbances or drug toxicity.
- Determine whether there is a physically large anterior-posterior diameter, a history of pericardial effusion, dilated cardiomyopathy, or pulmonary emphysema. **➤Rationale:** These conditions may result in ineffective external pacing because of transthoracic impedance.

### Patient Preparation

- Ensure that the patient and family understand preprocedural teaching. Answer questions as they arise and rein-

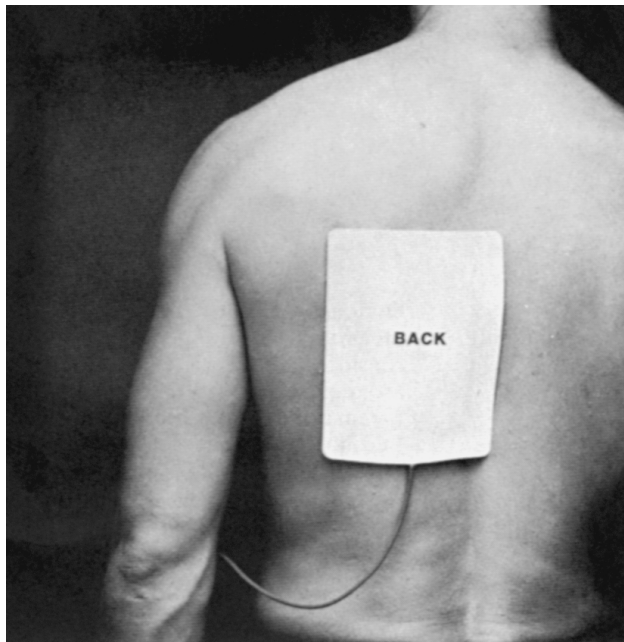
force information as needed. **➤Rationale:** Evaluates and reinforces understanding of previously taught information.

- Select chest and back placement sites and prepare the chest and back skin for placement of electrodes. Avoid contact with ECG electrodes, wires, and nitroglycerin patches and paste. **➤Rationale:** Adequately preparing the skin, avoiding placement over bony structures and external wires, clipping body hairs, and avoiding open skin areas will reduce discomfort associated with external pacing. Placement over nitroglycerin patches and paste prevents conduction of electric current. Do not use benzoin for adherence because it increases the potential for skin burns.
- Consider administering sedation before initiating pacing. **➤Rationale:** Transcutaneous pacing can be uncomfortable for the patient.

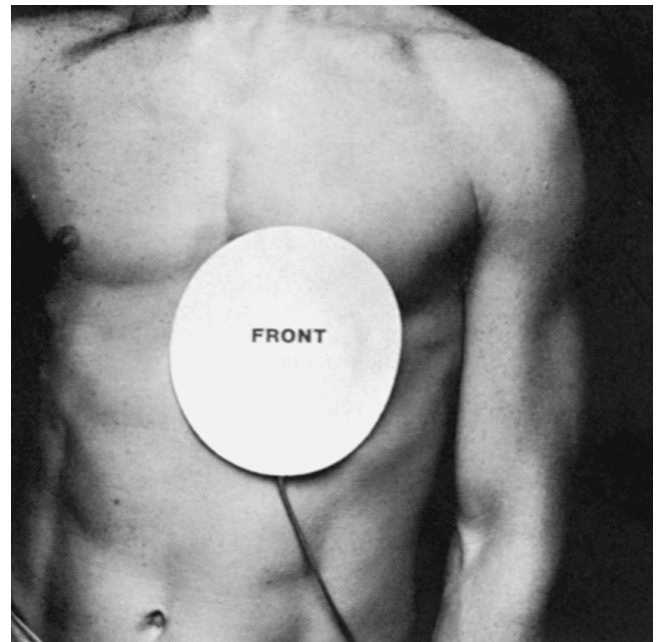
### Procedure for Temporary Transcutaneous (External) Pacing

Steps	Rationale	Special Considerations
1. Wash hands.	Reduces transmission of microorganisms; standard precautions.	
2. Turn on pulse generator and monitor.	Ensures that equipment is functional.	Many devices work on battery or alternating current (AC) power.
3. Prepare the skin on the chest and back by washing with soap and water and trimming body hair with scissors, if necessary.	Removal of skin oils, lotion, and moisture will improve patch adherence and maximize delivery of pacing energy through the chest wall.	Optional step in an emergency. Skin preparation is an important consideration if high levels of energy are required for capture. Avoid use of flammable liquids to prepare skin (alcohol, benzoin) because of increased potential for burns. Avoid shaving chest hair because the presence of nicks in the skin under the pacing patches greatly increases patient discomfort.
4. Apply ECG electrodes of conventional three-lead, single-channel monitoring system. Connect ECG cable to monitor inlet of pulse generator.	Checks intrinsic rhythm and pacer sensing function.	Attachment of the ECG cable is optional in an emergency if asynchronous pacing is initiated (ie, asystole).
5. Adjust ECG lead and size to maximum R wave size.	Detection of intrinsic rhythm is necessary for proper demand pacing.	Lead II usually provides the most prominent R wave. (This step is unnecessary with asystole or asynchronous pacing.)
6. Apply the back (posterior, +) pacing electrode between the spine and left scapula at the level of the heart (Fig. 45-2).	Placement of pacing patches in the recommended anatomic location will enhance the potential for successful pacing.	Avoid placement over bone, because this increases the levels of energy required to pace, causing greater discomfort and the possibility of noncapture.
7. Apply the front (anterior, -) pacing electrode at the left, fourth intercostal space, midclavicular line (Fig. 45-3).	Placement of the pacing patches in the recommended anatomic location will enhance the potential for successful pacing.	Adjust position of electrode below and lateral to breast tissue to ensure optimal patch adherence. Avoid placement of electrodes over permanently placed devices such as implantable cardioverter-defibrillators (ICDs) or permanent pacemakers.

*Procedure continued on following page*



■ ● **FIGURE 45-2.** Location of the posterior (back) pacing electrode. (From Zoll Medical Corporation, Burlington, MA.)



■ ● **FIGURE 45-3.** Location of the anterior (front) pacing electrode. (From Zoll Medical Corporation, Burlington, MA.)

### Procedure for Temporary Transcutaneous (External) Pacing *Continued*

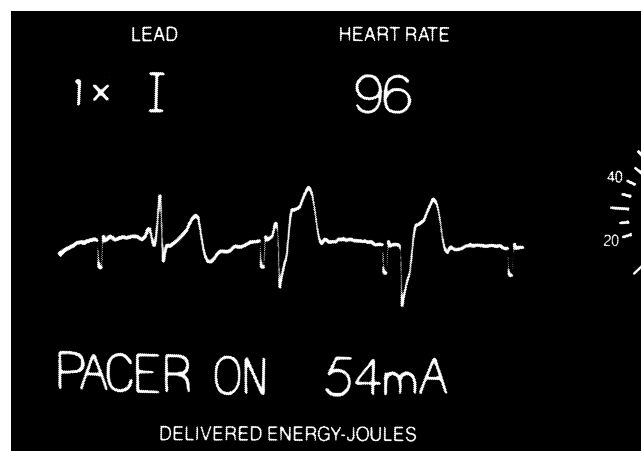
Steps	Rationale	Special Considerations
8. When the patient is too unstable to allow posterior placement, the back electrode may be placed over the patient's right sternal area at the second or third intercostal space. The front electrode will be maintained at the apex (fourth or fifth intercostal space, midclavicular line; ie, standard anterior-anterior defibrillation paddle placement).	Facilitates ease of electrode placement for emergent pacing.	Pacing may be less effective with this method of electrode placement. Avoid placement of electrodes over bone, because this increases the levels of energy required to pace, causing greater discomfort and the possibility of noncapture.
9. Connect pacing electrodes to cable and connect to external pulse generator.	Necessary for the delivery of electric energy.	
10. Consider administering sedation before initiating pacing.	Transcutaneous pacing can be uncomfortable for the patient.	Evaluate the patient's hemodynamic status before administering sedation because of the potential for hypotension.
11. Set pacemaker settings as prescribed by the physician or advanced practice nurse, including rate, level of energy (output, mA), and mode, if available (demand/synchronous, nondemand/asynchronous) (Fig. 45-4).	Each patient may require different pacemaker settings to provide safe and effective external pacing. Pacing should be maintained at a rate that maintains adequate cardiac output but does not induce ischemia.	Follow hospital standards to ensure that a nurse can initiate transcutaneous pacing. Attempt to use the lowest level of energy necessary to pace consistently. The average adult can usually be paced with a current of 40 to 70 mA. <sup>2</sup> Use demand mode if available and nondemand mode only in the absence of an intrinsic rhythm.
12. Initiate pacing by slowly increasing the energy level (mA) delivered until consistent capture occurs at the prescribed rate. This is the threshold.	Use the lowest amount of energy that consistently results in myocardial capture and contraction to minimize discomfort.	Follow the manufacturer's specific recommendations for setting the energy level (mA) above threshold to maintain assurance of consistent capture and to maximize patient comfort.



■ ● **FIGURE 45-4.** Pacemaker settings for external pacing. (From Zoll Medical Corporation, Burlington, MA.)

### Procedure for Temporary Transcutaneous (External) Pacing *Continued*

Steps	Rationale	Special Considerations
13. Monitor ECG tracing pacer artifact and associated capture or sensing (Fig. 45-5).	Ensures adequate functioning of the pacer.	It is possible to see pacer artifact without consistent myocardial depolarization. Reevaluate threshold and increase energy levels as appropriate. Evaluate the ability of the pacer to recognize or sense an early native QRS complex.
14. Palpate patient's carotid or femoral pulse.	Ensures adequate blood flow with paced complexes.	It is possible to have electrical activity without associated mechanical contraction.
15. Evaluate patient comfort.	Pacing may be tolerated or uncomfortable for the patient.	Adjustments in threshold, changes in pacer patch location, or medication for sedation may be required. <sup>3</sup>
16. Discard used supplies, and wash hands.	Reduces transmission of microorganisms; standard precautions.	



■ ● **FIGURE 45-5.** ECG tracing of external pacing. ECG, electrocardiogram. (From Zoll Medical Corporation, Burlington, MA.)

Expected Outcomes	Unexpected Outcomes
<ul style="list-style-type: none"> <li>• Adequate systemic tissue perfusion and cardiac output as evidenced by blood pressure greater than 90 mm Hg systolic, alert and oriented patient, absence of dizziness or syncope, absence of shortness of breath, absence of nausea and vomiting caused by hypotension, and absence of ischemic chest pain</li> <li>• Stable cardiac rhythm</li> <li>• Adequate pacer function</li> </ul>	<ul style="list-style-type: none"> <li>• Failure of the pacemaker to sense patient's underlying rhythm with the possibility of R-on-T phenomenon (initiation of ventricular tachydysrhythmias as a result of an improperly timed spike on the T wave)</li> <li>• Failure of the pacemaker to capture the myocardium</li> <li>• Failure of the pacemaker to pace</li> <li>• Discomfort, including skin burns from the delivery of high levels of energy through the chest wall, painful sensations, and skeletal muscle twitching</li> </ul>

### Patient Monitoring and Care

Patient Monitoring and Care	Rationale	Reportable Conditions
		<i>These conditions should be reported if they persist despite nursing interventions.</i>
1. Monitor vital signs hourly and as needed.	Ensures adequate tissue perfusion with paced beats. Adjustments in pacing rate may need to be made based on vital signs.	<ul style="list-style-type: none"> <li>• Change in vital signs associated with signs and symptoms of significant hemodynamic deterioration</li> </ul>
2. Monitor level of comfort: <ul style="list-style-type: none"> <li>○ Assess level of comfort.</li> <li>○ Administer analgesic or sedative as needed.</li> <li>○ Adjust level of energy to lowest level.</li> <li>○ Evaluate patient response to interventions.</li> </ul>	External delivery of energy through the chest wall may cause varying degrees of discomfort.	<ul style="list-style-type: none"> <li>• Pain unrelieved by prescribed medications or interventions; patient intolerant of the prescribed medications (ie, severe nausea, hypotension, decreased respirations)</li> </ul>
3. Obtain ECG recording to document pacing function every 4 hours and as needed.	Documentation of pacemaker efficacy is necessary for the patient record.	
4. Evaluate pacemaker function (capturing and sensing) with any changes in patient condition or vital signs.	Ensures continued functioning of pacemaker. Introduction of other variables such as electrolyte imbalance or metabolic changes may alter the level of energy required to pace effectively.	<ul style="list-style-type: none"> <li>• Inability to maintain appropriate sensing and capture</li> <li>• Changes in patient condition that may affect appropriate pacer function and require physician intervention</li> </ul>
5. Monitor heart rhythm for resolution of the hemodynamically significant dysrhythmia requiring treatment. This may require turning the pacemaker off to assess the underlying rhythm.	Indicates whether external pacing has been an effective method of treatment. Some manufacturers have the 4:1 feature (ie, Zoll allows assessment of baseline rhythm without turning the pacer off).	<ul style="list-style-type: none"> <li>• Worsening of the baseline cardiac rhythm (eg, change from symptomatic second-degree heart block to complete heart block)</li> </ul>
6. Evaluate the hemodynamic response to pacing by comparison to the baseline.	Evaluates the patient's physiologic response to pacing and ensures that it is optimal.	<ul style="list-style-type: none"> <li>• Significant hemodynamic deterioration</li> </ul>
7. Monitor skin integrity under the electrodes. <ul style="list-style-type: none"> <li>○ Assess skin integrity with routine physical assessment, minimally once every 24 hours but more frequently if pacing or defibrillation recurs through multifunction electrodes.</li> <li>○ Change electrodes at least every 24 hours.</li> </ul>	Change in skin integrity caused by burns or skin breaks will significantly alter patient's level of comfort and expose the patient to possible infection.	<ul style="list-style-type: none"> <li>• Changes in skin integrity</li> </ul>

## Documentation

- Patient and family education
- Patient preparation
- Date and time transcutaneous pacing is initiated
- Description of events warranting intervention
- Vital signs and physical assessment before and after transcutaneous pacing
- ECG recordings before and after pacing
- Patient tolerance and comfort level and related interventions
- Any medications administered during the initial procedure
- Pacing rate
- Threshold level
- Milliampere setting (mA)
- Mode of pacing
- Percentage of time paced if in demand mode
- Status of skin integrity when pacing electrodes are changed
- Unexpected outcomes
- Additional interventions

## References

1. American Heart Association, Emergency Cardiac Care Committee and Subcommittees. Guidelines for cardiopulmonary resuscitation and emergency cardiac care. *JAMA*. 1992;268:2213–2214.
2. Moses HW, Moulton KP, Miller BD, Schneider JA. *A Practical Guide to Cardiac Pacing*. Boston, Mass: Little, Brown, and Co; 1995:105–108.
3. Atlee JL. *Arrhythmias and Pacemakers*. Philadelphia, Pa: W.B. Saunders; 1996:270–274.

## Additional Readings

American Heart Association, Emergency Cardiac Care Committee and Subcommittees. Guidelines for cardiopulmonary resuscitation and emergency cardiac care. *JAMA*. 1992;268:2213–2214.

Appel-Hardin S. The role of the critical care nurse in noninvasive temporary pacing. *Crit Care Nurse*. 1992;12:9–10.

Beeler L. Noninvasive temporary cardiac pacing in the emergency department: a review and update. *J Emerg Nurs*. 1993;19:202–205.

Braun AE. Emergency cardiac care: a quick response to life-threatening arrhythmias. *RN*. 1994;57:54–63.

Paraskos JA, Watts S. Emergency cardiac pacing. *Hosp Med*. 1996;32:35–41.

Pezzella DA. External pacing. *Prog Cardiovasc Nurs*. 1989;4:18–22.

Teplitz L. External pacemakers. *J Cardiovasc Nurs*. 1991;5:44–57.

Waggoner PC. External cardiac pacing. *AACN Clin Issues Crit Care Nurs*. 1991;2:118–125.

Wertz EM. External cardiac pacing. *Emergency*. 1994;26:53–56.

Winslow EH. Research for practice. External pacing in the field: poor results. *Am J Nurs*. 1994;94:24.